**What is claimed is:**

1. An electron source comprising:

an anode;

a cathode comprising an electron emitting portion and having a cathode axis;

an electromagnetic radiation source adapted to generate an electromagnetic radiation beam to heat the cathode; and

a lens adapted to direct the electromagnetic radiation beam onto the cathode, the lens having a lens axis that forms an acute angle with, or is substantially parallel to, the cathode axis.

2. An electron source according to claim 1 wherein the cathode comprises a beam-receiving portion and the lens is adapted to direct the electromagnetic radiation beam onto the beam-receiving portion.

3. An electron source according to claim 2 wherein the beam-receiving portion is a different portion of the cathode than the electron emitting portion.

4. An electron source according to claim 2 wherein the beam-receiving portion comprises a substantially concave surface.

5. An electron source according to claim 1 wherein the electron emitting portion comprises tungsten.

6. An electron source according to claim 1 wherein the cathode comprises a rod that terminates in the electron emitting portion, and wherein the lens is attached to the rod.

7. An electron source according to claim 1 wherein the electromagnetic radiation source is adapted to heat the cathode to at least about 1800 Kelvin.

8. An electron source according to claim 1 wherein the lens comprises aluminum oxide.

9. An electron source according to claim 1 comprising an electromagnetic radiation detector to detect radiation reflected from the cathode to determine a property of the cathode.

10. An electron beam apparatus to register an electron beam pattern on a substrate, the apparatus comprising:

a vacuum chamber;

a substrate support to support a substrate;

an electron source to provide an electron beam in the vacuum chamber, the electron source comprising (a) an anode, (b) a cathode comprising an electron emitting portion and having a cathode axis, (c) an electromagnetic radiation source adapted to generate an electromagnetic radiation beam to heat the cathode, and (d) a lens adapted to direct the electromagnetic radiation beam onto the cathode, the lens having a lens axis that forms an acute angle with, or is substantially parallel to, the cathode axis; and

an electron beam modulator and scanner to modulate and scan the electron beam across the substrate to register an electron beam pattern on the substrate.

11. An apparatus according to claim 10 wherein the cathode comprises a beam-receiving portion and the lens is adapted to direct the electromagnetic radiation beam onto the beam-receiving portion.

12. An apparatus according to claim 11 wherein the beam-receiving portion is a different portion than the electron emitting portion.

13. An apparatus according to claim 11 wherein the beam-receiving portion comprises a substantially concave surface.

14. An apparatus according to claim 10 wherein the electron emitting portion comprises tungsten.

15. An apparatus according to claim 11 comprising a rod that connects the lens and the beam-receiving portion of the cathode.

16. An apparatus according to claim 10 wherein the electromagnetic radiation source is adapted to heat the cathode to at least about 1800 Kelvin.

17. An apparatus according to claim 10 wherein the lens comprises aluminum oxide.

18. An apparatus according to claim 10 wherein the electron source comprises an electromagnetic radiation detector to detect radiation reflected from the cathode to determine a property of the cathode.

19. A method of generating electrons from an electron source comprising an anode, and a cathode having an electron emitting portion and a cathode axis, the method comprising:

(a) negatively biasing the cathode relative to the anode; and

(b) directing an electromagnetic radiation beam onto the cathode at an acute angle with, or substantially parallel to, the cathode axis.

20. A method according to claim 19 comprising directing the electromagnetic radiation beam onto a beam-receiving portion of the cathode.

21. An method according to claim 19 comprising heating the cathode to at least about 1800 Kelvin.

22. An method according to claim 19 comprising detecting a radiation reflected from the cathode and determining a property of the cathode.

23. An electron source comprising:

an anode;

a cathode comprising an electron emitting portion having a tip, a beam-receiving portion, and a cathode axis;

a laser beam source adapted to generate a laser beam to heat the cathode; and

a lens adapted to focus the laser beam onto the cathode, the lens being supported by a rod that is substantially parallel to the cathode axis and terminates in the electron emitting portion of the cathode.

24. An electron source according to claim 23 wherein the lens comprises a lens axis that forms an acute angle with or is substantially parallel to, the cathode axis.

25. An electron source according to claim 23 wherein the beam-receiving portion is a different portion of the cathode than the electron emitting portion.

26. An electron source according to claim 23 wherein the beam-receiving portion comprises a substantially concave surface.

27. An electron source according to claim 23 wherein the electron emitting portion comprises tungsten.

28. An electron source according to claim 23 wherein the electromagnetic radiation source is adapted to heat the cathode to at least about 1800 Kelvin.

29. An electron source according to claim 23 wherein the lens comprises aluminum oxide.

30. An electron source according to claim 23 comprising an electromagnetic radiation detector to detect radiation reflected from the cathode to determine a property of the cathode.

31. A method of registering an electron beam pattern on a substrate, the method comprising:

(a) placing a substrate on a substrate support;

(b) generating an electron beam by (i) biasing a cathode relative to an anode, and (ii) generating an electromagnetic radiation beam and directing the electromagnetic radiation beam onto the cathode to heat the cathode; and

(c) modulating and scanning the electron beam across the substrate to register an electron beam pattern on the substrate.

32. A method according to claim 31 comprising directing the electromagnetic radiation beam on a beam-receiving portion of the cathode.

33. An method according to claim 31 wherein the electromagnetic radiation beam is capable of heating the cathode to at least about 1800 Kelvin.